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Abstract

PROBLEMS AND PERFORMANCE OF NPD

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1. The NPD (Nuclear Power Demonstration) reactor is a 20-MW(e) prototype designed to show the technical feasibility of building and operating nuclear power stations with heavy-water moderator, heavy-water coolant, horizontal pressure tubes, refuelling at full power and a natural UO_2 fuel with no reprocessing. It is the forerunner for the CANDU reactor and other large units designed to produce power economically.

2. The NPD reactor went critical in April 1962, and reached full power in June 1962. Since October 1962 the time has been divided between "Capacity Runs" and "Improvement/Test Periods".

3. The "Capacity Runs" correspond to normal operation of a base-load station, and are intended to prove reliability (high capacity factor) and to identify deficiencies. During the "Improvement/Test Periods", improvements are made to eliminate the deficiencies, and special tests and inspections associated with the pioneer nature of NPD are carried out.

4. In three "Capacity Runs", totalling 29 weeks, the capacity factor has averaged 78%. The major causes of lost production have been eliminated and capacity factors of 90% are anticipated in future. "Capacity Runs" lasting 12 months are planned.

FUEL

5. None of the fuel has failed. By December 1, 1963, the centre fuel had reached 3800 MWd/tonne and average burn-up was 1300 MWd/tonne. Design rating of the fuel is 6500 MWd/tonne but some fuel will be exposed much longer.

ON-POWER FUELLING

6. The fuelling machines have performed over 1500 operations at low power and low temperature. The first attempt at high power on December 3, 1962, was a failure. A large spill of heavy water occurred when the seal between one fuelling machine and the reactor failed.

7. The sealing mechanism has been improved and instruments have been developed to measure the seal performance.

8. On November 24, 1963, on-power fuelling became a reality and NPD became the first high-pressure reactor with this ability.

PRESSURE TUBES

9. An in-reactor inspection of one of the Zircaloy pressure tubes was carried out in October, 1963, after 17 months of operation. The tube surface was in excellent condition, with negligible damage due to fuel movement. Another inspection is planned in October, 1964, and later a tube may be removed for more detailed examination and testing.

PRIMARY-PUMP SEALS

10. The main D_2O coolant pumps are standard pumps with mechanical shaft seals. Long seal life is vital. At first, dissolved gas in the coolant caused seals to fail after a few hundred hours. Since then, dissolved gas has been greatly reduced and seal venting has been improved. As a result, seals recently inspected after 3000 hours are in excellent condition.

STATION CONTROL

11. Reactor control and response to disturbances have been excellent.

D_2O LOSSES

12. These are still somewhat above pre-operation estimates. Sophisticated leak-detection techniques are being used to reduce them.